VOICE OVER PACKET NETWORK PHONE

INVENTOR

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BACKGROUND OF THE INVENTION

1.   Field of the Invention.

This invention relates generally to Internet telephony and, more particularly, to data packet network telephones.

2.   Related Art.

Shown in FIG. 1 is a diagrammatic illustration of a typical known communications system where computers 14, 16 are connected by network cables to a packet data network, for example Ethernet backbone 18, and telephones 2, 4, 6 are connected by circuit switched telephone wires to a telephone system 8 and private branch exchange (PBX) 10. Communications involving computers 14, 16 occur by the exchange of data packets through a packet network having many routers, network cables, and optionally public switched telephone network (PSTN) 12. Communications involving telephones 2, 4, 6 occur by establishing a circuit connection between calling and called telephones. Having two separate network systems requires maintaining two systems. Further, since a typical office has at least one computer and one telephone, the associated wiring for each office must be able to support both packet and circuit communications and requires that each office have wiring to support both packet and circuit communications. The complexity in the wiring and the maintenance of two network systems may be great and inefficient.

Recently, voice over packet network (VOPN) phones that use a packet network to send and receive data packets of voice phone calls have been introduced. VOPN technology has simplified the wiring in a typical office such that the same type of network cable may be used for both the computer (e.g., for data processing) and the phone. In a typical office setup, both the VOPN phone and the computer use the same

network connection to the data packet network. That is, all data packets to and from the computer and all data packets to and from the VOPN phone are processed by the same network connection. Since data packets to and from the computer are typically much larger than data packets to and from the VOPN phone, processing of the larger data packets may delay the processing of the data packets to and from the VOPN phone. One problem associated with the delay in processing the VOPN data packets is that a user of the VOPN phone may experience poor voice quality. Poor voice quality may be very noticeable to a user of the VOPN phone as echo, talk overlap, pauses or silences in communication. The poor voice quality may make VOPN phone technology unattractive for some users. Further, the poor voice quality may be annoying and frustrating to a user of the VOPN phone. Accordingly, a need exists for a means for processing data packets over a packet network that improves voice quality in a VOPN phone.

SUMMARY

One embodiment of the invention is a method for processing data packets exchanged over a packet network having data packets and voice packets. The method includes receiving data packets from a data processing device and determining whether the data packets need to be divided into smaller data packets. If the data packets need to be divided, then dividing the data packets into divided data packets and interspersing the divided data packets among the voice packets. In addition, the method includes sending the data packets, including the smaller data packets if divided, and the voice packets to a communications network. In one embodiment, data packets to and from the voice packets have a higher priority than the data packets.

Under another embodiment of the invention is a phone system for processing data packets exchanged over a packet network that has data packets and voice packets. The system includes a user interface with the ability to place and receive phone calls that include voice packets. The system also includes a network manager coupled to the user interface, the data processing device and the packet network. The network manager determines whether to divide the data packets and intersperse the divided data packets among the voice packets.

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Other systems, methods, features and advantages of the invention will be apparent to one with ordinary skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE FIGURES

The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. In the figures, like reference numerals designate corresponding parts throughout the different views.

FIG. 1 illustrates a prior art communications system with computers and telephones.

FIG. 2 illustrates a communications system utilizing an embodiment of the invention.

FIG. 3 illustrates a system architecture diagram for an embodiment of the invention.

DETAILED DESCRIPTION

Shown in FIG. 2 is a communications system utilizing a packet network for phone calls and for data transmission. In the illustrated embodiment, a VOPN phone 24 is coupled to a computer 18 by, for example, network cables 20, 22. The computer 18 is connected to an associated VOPN phone 24 and the VOPN phone 24 connects directly to a packet data network, for example Ethernet LAN 26. Further, communications between phones 24, 30, 32, 36 occur via the packet network (e.g. the Ethernet LAN 26 in the illustrated example). For example, in FIG. 2, a phone call between the VOPN phone 24 and the telephone 32 occur utilizing the packet network of The Ethernet LAN 26. Additionally, communications to facsimile machine 34 from either a computer 18, 28 or a VOPN phone 24, 30, 36 may occur utilizing the packet network of The Ethernet LAN 26 and a PSTN 12. Shown in FIG. 2 is a packet network adhering to Internet Protocol (IP) standards. The use of IP is meant to be illustrative and any other packet network (for example, frame relay and Asynchronous

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Transfer Mode (ATM)) may be used.

In general, a VOPN phone processes packets to and from a packet network and packets to and from a computer to allow a user of the VOPN phone to make and receive phone calls. As shown in FIG. 2, the VOPN phone 24 processes packets received from and sent to the Ethernet LAN 26 and the VOPN phone 24 passes packets received from the computer 18 to the Ethernet LAN 26. When the VOPN phone 24 receives a packet from the Ethernet LAN 26, the VOPN phone 24 determines whether the packet is destined for the VOPN phone 24 or whether it is destined for the computer 18. If a packet is destined for the computer 18, the VOPN phone 24 sends the packet to the computer 18.

Referring now to FIG. 3, in order to process packets containing voice, a VOPN phone 50 may, for example, include at least one or more of an external interface 40, user interface 42, voice interface 44, processor unit 46 and network manager 48. External interface 40 may provide communication to an external device for example a personal digital assistant (PDA). For example, telephone numbers stored in VOPN phone 50 may be transferred to a PDA via the external interface 40. User interface 42 may provide the conventional user interface functions of a telephone, for example a keypad for dialing numbers, an audible indicator for incoming calls, a display for presenting messages and caller identification information, and additional keys for mute, hold, redial, etc. Voice interface 44 may provide conversion of analog voice into digital samples. Processor unit 46 may perform the voice processing, call processing, and protocol processing functions of the VOPN phone 50. To perform these functions, processor unit 46 may comprise a central processing unit (CPU) 54, a voice processor 56, and memory, for example RAM 52.

Network manager 48 may manage the transmission and reception of packets from the Ethernet LAN 26 and the computer 58. In an illustrative embodiment of the invention, the network manager 48 breaks up large packets from the computer 58 and large packets destined for the computer 58 into a number of smaller packets. Large packets are defined as packets with a packet size greater than a defined threshold. For example, a packet from the computer 58 or a packet destined for the computer with a packet size of 2500 bytes may be broken up into 5 packets of 500 bytes each. Further,

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the smaller packets are interspersed among packets directed to and from VOPN phone 50. The network manager 48 generates smaller packets, referenced here as packets a, b, c, d, and e. If the network manager 48 then needs to process packets directed to or from VOPN phone 50, referenced here as f and g, then network manager 48 may reorder processing of the packets to f, a, g, b, c, d, and e. By breaking up large packets to and from the computer 58 and placing the smaller packets among packets to and from VOPN phone 50, packets to and from VOPN phone 50 are processed more quickly.

In an alternative embodiment of the present invention, the network manager 48 may place a higher priority on packets to and from the VOPN phone 50 over packets to and from the computer 58. Higher priority means to process packets to and from the VOPN phone 50 before packets to and from the computer 58. In the above example, packets f and g are processed before a, b, c, d, and e. Further, if while the network manager 48 is processing packet a, the network manager 48 receives packets f and g, then packets f g are processed after packet a and before packets b, c, d, and e. By placing a higher priority on the packets to and from the VOPN phone 50, the packets to and from the VOPN phone 50 are more quickly processed than in prior art systems.

The network manager 48 may implement schemes to allow the user of a VOPN phone to place higher emphasis on computer packets than on VOPN packets. For example, if a user of the VOPN phone 50 decides not to place higher priority on packets to the and from the VOPN phone 50 then the network manager 48 may implement a priority scheme to allow data packets to and from the computer 58 to be processed with a higher priority. In yet another embodiment, the network manager 48 may implement varying levels of priority on all the packets it processes. For example, the network manager 48 may implement a four level priority scheme where each data packet is assigned one of four priority levels. The four priority levels may be described as highest, high, medium, and low where all data packets assigned the highest priority are processed before those that are assigned high priority. Thus, a packet to and from the computer 58 which is assigned the highest priority may be processed before a packet to and from the VOPN phone 50 which is assigned a high priority while packets to and from the computer 58 are normally assigned a medium priority.

In an illustrative embodiment of the present invention, the network manager 48 may adhere to 10BaseT or 100BaseT Ethernet running TCP/IP protocols. Further, the network manager 48 may include two Ethernet transceivers. One transceiver may be used to interface to the communications network and the other transceiver may be used to interface to a data processing device, for example the computer 58. In another embodiment, the network manager 48 may comprise one transceiver that functions to interface to both the communications network and a data processing device, for example the computer 58. Although the use of 10BaseT and 100BaseT Ethernet is mentioned, such protocols are illustrative and any alternative networking protocol may be utilized.

As an example of the use of the communications system of FIG. 2, when a user (as used herein, "caller") of VOPN phone 24 wishes to communicate with another phone user, the caller may place a call on the VOPN phone 24. The call is placed and connected through The Ethernet LAN 26 to the receiving user (as used herein, "called user"). It is important to note that the called user may not be using a VOPN phone or may not even be connected to a packet network, for example the Ethernet LAN 26. As shown in FIG. 2, the called user may be using a telephone 32 connected to the PSTN 12. Further, the called user may be associated with telephonic devices connected to packet networks, or to circuit switch networks, for example the facsimile 34 in FIG. 2.

The VOPN phone 24 sends and receives data packets containing voice (as used herein, "voice packets") to the Ethernet LAN 26. An illustrative embodiment of the invention places a higher priority on voice packets than on non-voice packets. Higher priority means to process voice packets before non-voice packets. By processing voice packets before non-voice packets, quality of service may be improved by reducing the delay associated with processing voice packets.

Further, another illustrative embodiment of the invention breaks up large non-voice packets and places a higher priority on voice packets than on non-voice packets. The VOPN phone 24 may check the size of non-voice packets received from either the computer 18 or from The Ethernet LAN 26. When the VOPN phone 24 receives a packet, it may first be checked to see if it is a voice packet. If it is, then the voice packet may immediately be processed. If it is not a voice packet, then the VOPN

phone 24 may determine the size of the non-voice packet. If the non-voice packet is larger than a defined threshold, then, in one embodiment, the VOPN phone 24 divides the larger non-voice packet into smaller non-voice packets. The smaller non-voice packets may be uniformly broken up or the non-voice packets may be randomly broken up. For example, a non-voice packet of 2500 bytes may be broken up into 5 non-voice packets of 500 bytes each. These 5 non-voice packets may be interspersed among voice packets so that voice quality may not degrade from having to process large non-voice packets. In another example, a non-voice packet of 2500 bytes may be broken up into 6 non-voice packets of 400, 350, 550, 600, 225 and 375 byte non-voice packets.

In operation, an embodiment of the present invention may process data packets exchanged over a packet network by (a) receiving data packets from a data processing device, (b) determining whether the data packets need to be divided into smaller data packets, dividing the data packets into divided data packets if determined to be needed and interspersing the divided data packets among the voice packets, and (c) sending the data packets, including the smaller data packets if divided, and the voice packets to a communications network.

While various embodiments of the invention have been described, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible that are within the scope of this invention.